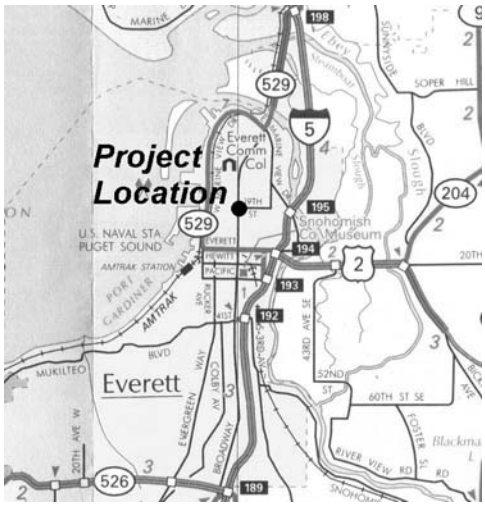
MGS Flood
Example Design Problems

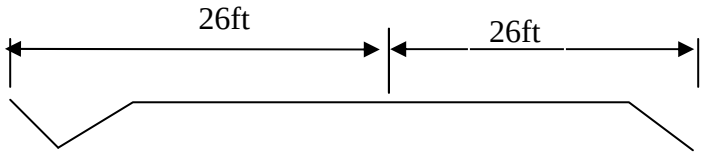
Work Session I
Roadway Widening Problem, Manual Pond Design

A section of highway near the city of Everett is to be improved with an additional lane in each direction.



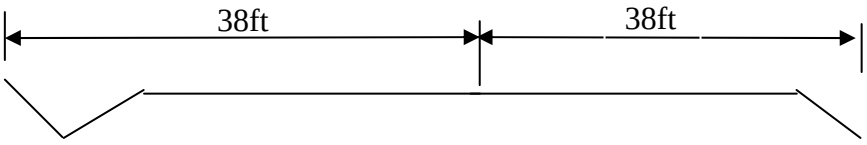
Project Location Map

The existing configuration consists of one 12-foot lane with a 6-foot shoulder on one side and an 8-foot shoulder on the other (including ditches) in each direction.



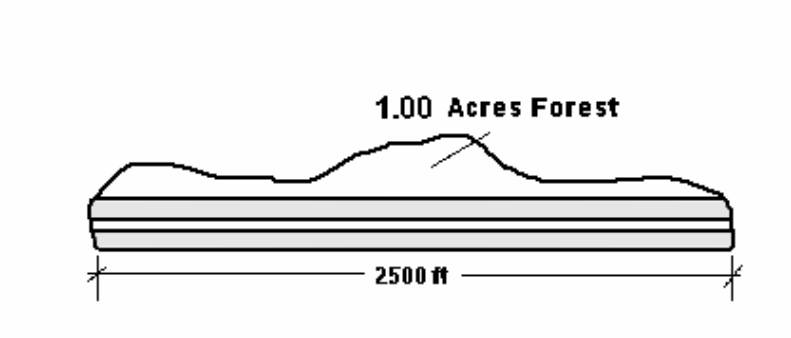
Existing Condition

The project will add one 12-foot lane in each direction, while maintaining the current shoulder widths. Both lanes will be added on the outside of the existing lanes.



Proposed Condition

Runoff from 1.0 acres of forestland upslope of the project will be intercepted by the roadway ditch and discharged to the stormwater pond.



The project is located on Alderwood soils, which are classified as SCS Hydrologic Group C.

Using this information, design a detention pond for this 2,500 foot section of roadway according to the Washington State Department of Ecology flow duration standard. Use the *Routing Table* option on the *Pond Design* tab.

Analysis Steps

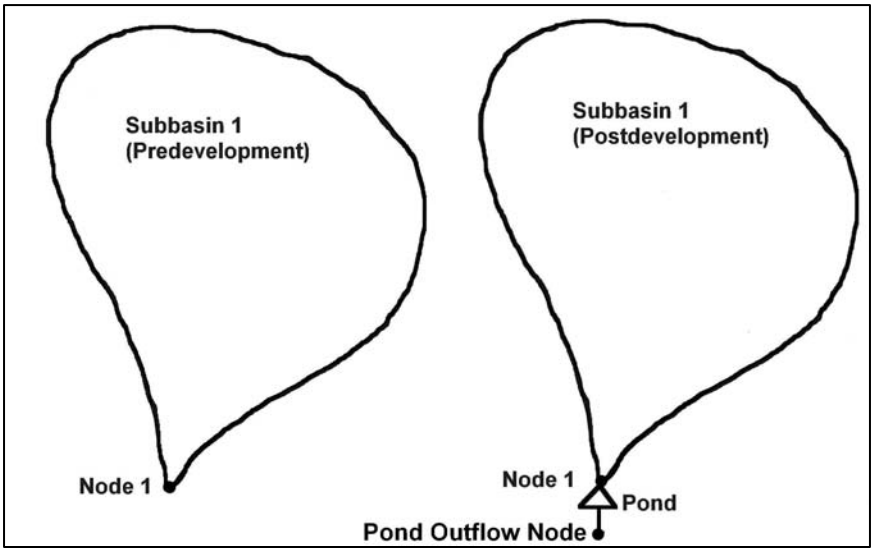
Start Program, Save Project File

1. Start program from Windows Start button
   Start-Programs-MGS Software-MGSFlood
2. Click File Save as, Enter "Dogwood" for Project Title. Create project folder when prompted

Project Location Tab

3. Enter project name, analysis title, and comments.
4. Check the Extended Precipitation Timeseries Option Button
5. Click the *Map* button under Climate or refer to the printed copy of the map. Locate the project on the map. Note the Timeseries Region and the mean annual precipitation for the project. Click the X on the Map window to close it.
6. Select Climate Region 10. Puget East 36 in MAP from the drop down list box.

Watershed Layout Tab



7. Compute Pre- and postdeveloped area.

Predeveloped:

Existing Impervious:
(26'+26')*2500'=130,000/43560 = 2.984 ac
Total predevelopment Impervious: 2.984 ac

Forest:
Off-site Forest Run-on = 1.0 ac
New Lanes = (12'+12')*2500' = 60000/43560= 1.377 ac
Total predevelopment Forest: 2.377 ac

Total Tributary Area: 5.361 ac

For SCS Type C soil, use Till

Postdeveloped:

Developed Impervious:
According to the Ecology Manual, we can only use an area equal to ½ of the new impervious surface as existing Impervious. The rest must be Forest

(38'+38')*2500'= 190,000/43560 = 4.361 ac

Total postdevelopment Impervious: 4.361 ac

Forest:
Off-site Forest Run-on = 1.0 ac

Total postdevelopment Forest: 1.00 ac

Total Tributary Area: 5.361 ac

8. Click the Subbasin Definitions button

   Enter land use from above
   Connect Subbasin 1 to Node 1
   Click OK

Node 1 will be used as the pond inflow. No node connections need to be defined. We're done with the Watershed Layout tab.

Compute Runoff tab

9. *The Simulation Time Span* is set to the full period of record of precipitation. No changes here.
10. Runoff from Node 1 will be saved. Enter a more meaningful name for Node 1, like "Pond Inflow"
11. Compute runoff for the full period of record. Click the *Run* button.

PLEASE WAIT BEFORE PROCEEDING

Pond Design Tab

12. Check *Use Routing Table* Option Button.

Tools Tab

We need to compute the predeveloped flow frequency information to design the pond.

13. Click the *Frequency Only* Option Button
14. Click the *Run* button to compute flow frequency statistics for the pre and post developed runoff at Node 1.
15. Click the View Report button from the tool bar on top of the screen to view the statistics. Scroll down about half way to the table of Flow Frequency for Data for Selected Recurrence Intervals.
    Note the 2-year and 50-year predeveloped flow rates. We'll need them for pond design using the spreadsheet program.
    Q2= 0.741 cfs
    Q50 =1.575 cfs
16. Click the *Close* button to close the project report.

Pond Design Using Spreadsheet

17. Open *PondHydraulics.xls*
    a. Enter new impervious surface (1.377 ac)
    b. Enter ½ 2-yr, 2yr and 50-year predeveloped peak flow.
    c. Enter pond bottom area such that storage at overflow equals initial volume at 3200sf
    d. Enter pond Side slope at 4:1
    e. Set Orifice #1 diameter such that discharge equals 1/2 of the 2-year at bottom of Pond depth thus, the diameter will be 0.40inches and the elevation 100ft.
    f. Set elevation of Orifice #2 at elevation corresponding to 1/2 of the 2-year discharge at elevation 100.75ft
    g. Set diameter of orifice #2 such that total discharge from pond equals the 50-year predeveloped rate with a 1.5inch diameter.
    h. Set weir elevation for the riser at 103ft and the circumference length for riser at 56.52in.
    i. Set infiltration rate through pond bottom (if any), no infiltration.
    j. Copy rating table from *Rating Table* tab to MGSFlood and test performance.

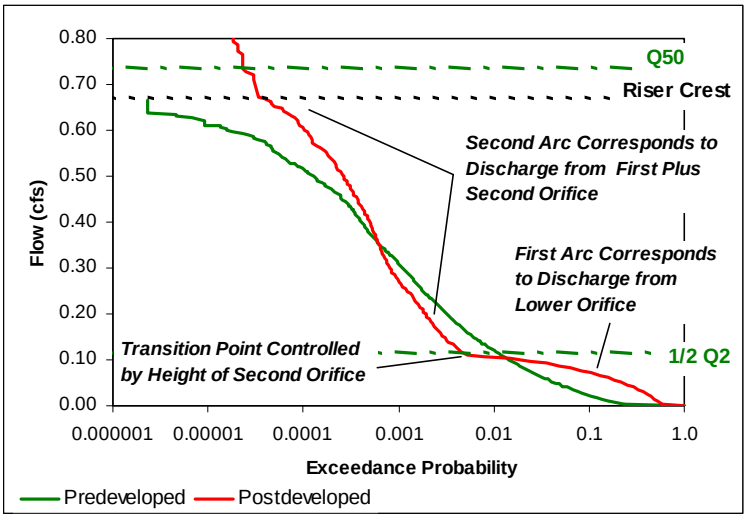
Pond Design Tab

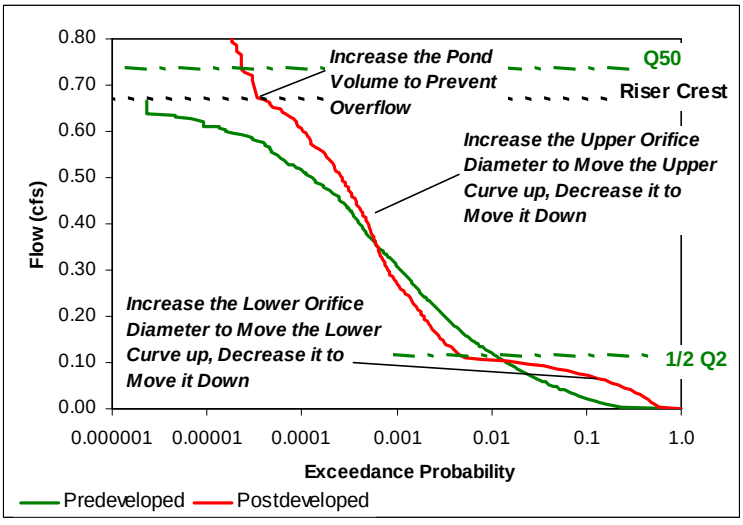
18. Paste rating table from PondHydraulics.xls to *Pond Hydraulic Routing* Table in MGSFlood

19. Make sure the *Pond Inflow* is set to Pond Inflow Node and the *Outflow* is set to Pond Outflow Node.
20. Check Compute Stats Plot Performance option button
21. Click the Route button to route flows, and plot performance. The program will plot the duration performance of the pond and indicate whether the performance meets the intended standard.
22. Make modifications using PondHydraulics.xls (See Below)
23. When finished, view documentation report either from the File Print menu or by opening the .rtf file with a word processor. Any graphs created during the analysis are stored in jpeg files in the project subdirectory.

General Guidance for Adjusting Pond Duration Performance

- Analyze the duration curve from bottom to top, and adjust orifices from bottom to top.
- The bottom arc corresponds with the discharge from the bottom orifice. Reducing the bottom orifice discharge lowers and shortens the bottom arc while increasing the bottom orifice raises and lengthens the bottom arc. ***(1. Increase bottom Orifice to 3.25 inches)***
- Inflection points in the outflow duration curve occur when additional structures (orifices, notches, overflows) become active.
- Lowering the upper orifice moves the transition right on the lower arc and raising the upper orifice moves the breakpoint left of the lower arc. ***(2. Raise Orifice 2 to101.5ft and increase the orifice to 3.5inches)***
- The upper arc represents the combined discharge of both orifices. Adjustments are made to the second orifice similar to the bottom orifice.
- Increasing the facility volume moves the entire curve down and to the left. This is done to control riser overflow conditions. Decreasing facility volume moves the entire curve up and to the right.

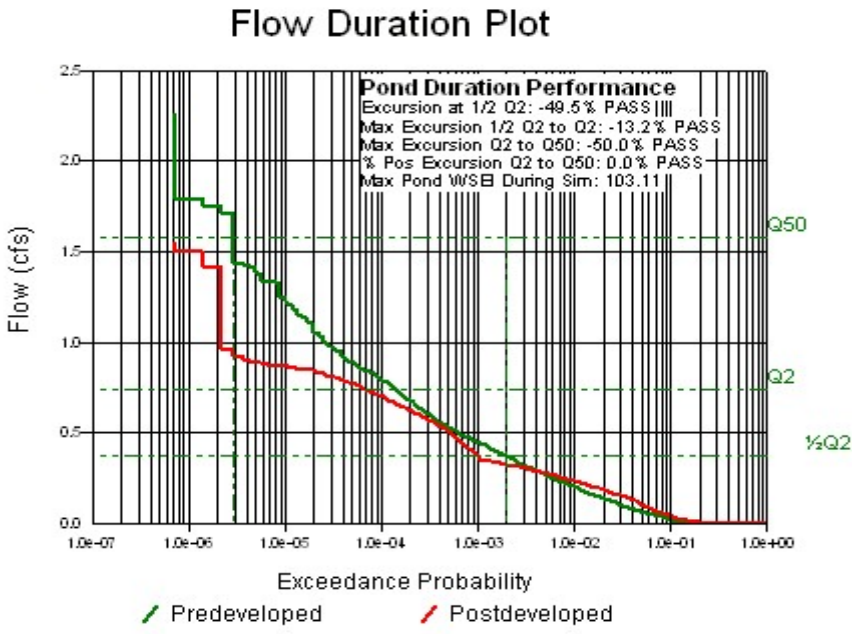


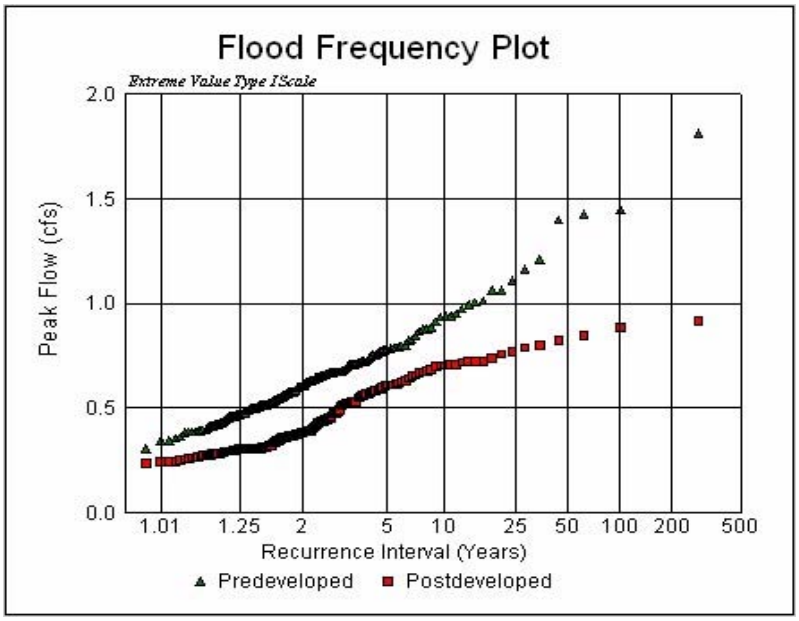


After Many Iterations, the following pond configuration was achieved:

Orifice #1:	Orifice #2:	Weir:
Elevation: 100.00’	Elevation: 101.5’	Elevation: 103.0’
Diameter: 3.25”	Diameter: 3.5”	Diameter: 18”

Pond Bottom Area: 3200 sf
Pond Volume at Riser Crest: **0.327 Ac-ft**
Pond Volume at Embankment: 0.405Ac-ft





Work Session II Water Quality Wet Pond Design Example

Determine a "basic" wet pond volume required for the roadway widening example.

Note: Ecology is currently working on a method to determine Water Quality wet pond volume using continuous-flow models. When the method is complete, MGSFlood will be modified to perform this calculation. A program upgrade will be provided at no charge.

Until then, water quality wet pond volume must be computed using the Curve Number Approach. The spreadsheet, *WQWetPondCalculator.xls* has been provided for this purpose.

Use the spreadsheet, *WQWetPondCalculator.xls* to compute the volume based on the following information:

Land Cover	Area (ac)	CN
Pervious Forest	1.000	72
Impervious	4.361	98

Per Table B.1, Ecology Manual:
2-Year, 24-hour precipitation at Everett: 1.46 inches,
P(6mo)/P(2-yr) = 0.75